Journal of the American Foundrymen's Association.

VOL. XI. SEPTEMBER, 1902. PART II.

DISCUSSION ON THE MELTING RATIO.

Mr. E. E. Russell Tratman, of Chicago reports to "The Engineer" of London on American Foundry Practice. In the issue of December 6th, 1901, he discusses the melting ratio. We give it herewith. "In some discussions as to the relative merits of different cupolas, or the efficiency of the work in different foundries, it has been assumed that the melting ratio—or the amount of iron melted per pound of coke—is a proper basis for comparison of results. This is entirely erroneous, for various reasons, the most important of which is that the proportion of iron to coke necessarily varies very considerably according to the character of the work to be cast. For small, thin, or intricate castings the metal must be very hot and fluid, requiring the consumption of a considerable quantity of coke, while large roughwork can be cast with iron at a lower temperature, and consequently with a higher melting ratio. Other reasons which weaken the comparison are the lack of uniformity in figuring the the quantities involved, the variation in the quality of the pig iron and coke, the size of the cupola, the total amount of the melt, and the length of the heat of the blast."

In the series of articles on "Cast Iron Pipe in the United States," published in "The Engineer," February to July, 1901, the general average of regular daily work was given as 10 lb. of iron per pound of coke, including the bed, although one of the pipe foundries described had a record of 12 to 1. An English critic claimed that 10 to 1 was very low, and intimated that his patent cupola could give ratios of 12 or 16 to 1 with a melt of 80 to 100 tons, and even better with small heats. No details were given as to the class of work, the conditions of working, or whether the figures included the bed. The

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present writer has no desire to institute invidious comparisons between American and English practice—there have already been too many such comparisons, made on insufficient and unequal bases; but it is fair to say that English records of foundry work do not appear to sustain such high claims for regular work. Ratios of 12 to 1 and even higher have been made at American foundries, but they usually represent special conditions and not regular daily practice. Two pipe foundries, however, even report records of 14 to 1 and 14.6 to 1. The latter was for very heavy pipe, which did not require very hot iron, and this was not considered satisfactory. In fact, it is generally recognised as poor practice to cut the coke supply too fine, at the risk of losing castings by having dead iron, cold shuts, etc. The character of foundry coke has already been discussed.

Particulars of the melting ratios of certain makes of cupolas have been given above under the heading of "Cupolas." Following up the English Criticism on this matter, the writer instituted some inquiries among foundrymen of acknowledged experience and foundries making different classes of work. From the replies received the following notes are taken:—

(1) Dr. Richard Moldenke, secretary of the American Foundrymen's Association, writes as follows:—"Your figure—10 to 1—is an average of the best American cupola practice, and that only for heavy output—50 tons and over—of uniform work. A good average for a jobbing foundry is 1 to 8½, more often it is 1 to 8. For small blows it is impossible to get over 1 to 6. My own results with an output of 15 tons was 1 to 5·8; 25 tons, 1 to 8·2; with 54 tons, 1 to 10·1. This, for railroad castings of uniform shapes and weight, with some heavy work thrown in, all in the same cupola. The best figures I ever obtained were in melting white irons for heavy annealing pots, in which work I could save coke, as the iron was not wanted hot. Here I got 1 to 11.8, and the heat was 65 tons. The very small heats used for cupola 'malleable' amounting to only 4 tons, seldom go better than 1 to 4."

(2) Mr. W. J. Keep says—"The amount of fuel required to melt iron depends on the kind of work to be poured. For very heavy castings it would be possible to do better than 10 to 1, but for light machinery it would be less, and for light hardware, &c., 9 to 1 would be good; and 7 or 8 to 1 is also good. We melt

more economically in the United States than they do in England. Iron hot enough to pour a casting ¼ in. thick was never melted with 16 to 1. Much depends on the method of figuring, and whether all materials are actually weighed. The proper way is to weigh all material, and count all coke in bed and in each charge. The coke and iron recovered in the dump should not be weighed, but should be charged next day along with new material, or else subtracted from the day's iron and weighed next day."

(3) Mr. Scott, whose foundry investigation work and foundry material specifications have already been referred to, says that at the Case foundry—making agricultural machinery—the melting ratio is about 1 to 8, but varies from 1 to 6 and 1 to 9, the latter figure being seldom attained. Much depends upon the size of the cupola and surrounding conditions. With a ratio of 1 to 6 you are sure to get a good hot iron ; with a ratio of 1 to 10 the chances are favorable to cold iron and trouble with 'cold shuts.' Ordinarily, 1 to 15 is impracticable, and when such cases are reported it is usually found on investigation that the foundryman forgot to include the 'bed' of coke. There is no economy in spoiling 15 tons of high-priced iron for the sake of saving half a ton of cheap fuel.

(4) At the General Electric Foundry, already described, the records for the past year show that for this period the ratio is a little over 9 lb. of iron to 1 lb of coke, which, in their opinion, represents about the average result obtained in large ironfoundries. They have however, kept records of individual melts where they were able to obtain over 10 lb. of iron to 1 lb. of coke, but this was where the conditions were very good and the melter was looking after the charge very carefully.

(5) "You have asked a question which is difficult for us to answer definitely, if the information is to be used for general purposes, for the reason that if we are given equal conditions as to cupola, volume and pressure of blast, &c., the melting ratio of coke depends principally upon two factors; the first being quality or composition of material being melted, and second, whether the blast is continued throughout the heat, or frequently interrupted on account of lack of facilities for taking away the metal. In the case of melting an all pig iron mixture for fine machinery castings, a ratio of 8 to 1 is considered fair, whereas a ratio of 10 to 1 we would consider as firstclass. However, if we were to melt, say, 40 per cent. of pig

iron containing about 2½ per cent. silicon, the remaining 60 per cent. to be made of all miscellaneous scrap iron, we expect, and do get, a result of 12 and 13 to 1 as an average. These figures are, of course, inclusive of the bed. I never heard of as large a ratio as 16 to 1, but if nothing but cheap scrap were melted, no doubt such a figure would be possible. Your figures of 10 to 1 as a general average I believe to be perfectly correct, and I base this belief upon the experience of some fifteen years' work."

(6) At the McCormick foundry, making parts for agricultural machinery, the average melting ratio is somewhat better than 10 to 1.

(7) The Westinghouse Company writes as follows:—"We buy our coke by the carload, and the weights given are all railroad weights. We are frequently compelled to pass railroad weights which are in excess of our own scale weights. During the year 1900 we purchased for our East Pittsburgh foundry a total of 3,731,000 lb. of coke. A certain proportion of this, impossible to account for accurately, was used in our brass foundry for melting stock in crucibles; a certain other proportion was employed in the making of cores, in order that the gases might be conveyed away readily in the core; a certain amount was probably employed in building open fires during the severe winter weather while our building operations were going on. If we dealt with the total coke purchased and the total iron melted, then we have a very low ratio, viz., about 5 lb. of iron per pound of coke. If, however, we depend upon the cupola man's detail reports of iron melted, and coke used, our average runs up somewhat higher, and the ratios, according to such reports, are more nearly 6½ to 1. We believe that there is a great deal of fallacy about the high reports which are oftentimes seen in print. Our practice is probably as good as the average foundry in this respect, and we are disposed to think that where ratios are high as 10 to 1 are reported that the party so reporting them is simply fooling himself. If he had the ways and means of comparing the total coke bought and paid for with his total iron melted he might discover a wide discrepancy. Our heats, as a rule, are comparatively short; we endeavor to melt as fast as we possibly can, in order to delay the time for our first pouring to as late in the afternoon as will enable us to finish up the day's work by our regular quitting time. As a consequence, our cupolas have to be charged on the first bed as usual, no matter how short the heat might be; and when we dump

the cupola at the close of heat we have the constant waste which is incident to this end of the operation. If we were melting continuously, as some foundries do, or as the Bessemer steel works frequently do, we would reduce very greatly the average loss at both ends of the melting, and make a better showing. In addition to this our castings are largely of the critical sort, and we must have our melt good and hot. We make this explanation to in part justify a ratio of coke to iron which might seem to be woefully poor. We have good cupolas, of most modern construction, and we feel that they are operated to fairly good effect. We run five cupolas in our East Pittsburgh foundry, although not always employing the total number, since our heats vary in size from day to day."

(8) "The average of 10 to 1 would be a fair proportion for melting iron for cast iron pipe purposes. We have melted as high as 14.6 tons of iron to 1 ton of coke in melting very heavy pipe. This is not a satisfactory ratio to work on, and we believe that your average melting ratio of 10 to 1 is as fair as possible to get. For light castings, stove plates, &c., an average of 1 to 7 is required."

(9) "As to our relative ratios for melting in our cupola practice for cast iron pipe, I beg to advise you that between 13 lb. and 14 lb. of iron to 1 lb. of coke is our usual practice when we are running our cupolas at their maximum. This includes beds."

(10) The Schenectady Locomotive Works reply that it is the practice of their foundry of melting 10 lb. of iron to 1 lb. of coke. The 72-hour Frick coke is used.

(11) The R. D. Wood Company, whose pipe foundry has been described in detail, state that the melting ratio depends so much upon the details surrounding each case that it would not be fair to make any general statement. "We have no doubt that in some of our cupolas we are using as much as 1 lb. of coke to 6 lb. of iron, while in others it may be as much as 1 lb. of coke to 15 lb. of iron. Pardon us for not being able to give a general average. The maximum or minimum are really all that is safe to speak of."

(12) Two makers of cupolas give the following replies:—(a) "Our experience is that 10 to 1 is a good ratio of iron to coke in cupola practice. It must be that the high ratio of English cupolas does not include the bed. We have known of ratios being compiled in this way before, but they would run even higher than 15 or 16. The best results are, of course, to be obtained in the larger

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sized cupolas and when running long heats." (b) "We believe that you are misinformed, not perhaps intentionally, but nevertheless erroneously, concerning the ratio of melting in England, especially in small heats where you state they claim to run from 15 to 16 to 1. We have some records of our furnaces melting as high as 14½ to 1; we consider this exceptionally high, and in our travels about the country we find that 10 to 1 is considered good melting, and information we have heretofore received from England would lead us to believe that a much lower ratio was run, running down as low as 5 or 8 to 1."

DISCUSSION ON THE STANDARDISATION OF CAST IRON PIPES.

The Iron and Coal Trades Review, August 1st, gives the following on this subject:—The British Association of Waterworks Engineers recently appointed a committee to report on the desirability and feasibility of adopting some satisfactory basis for standardisation of cast-iron pipes, and the amount of support likely to be secured in the event of the matter being put into practical shape.

With this object in view a circular was drawn up containing the following questions,—

1. Do you consider it generally advisable that the dimensions, weights, etc., of cast-iron pipes should be standardised in this country?

2. Are you of the opinion that such a standard could be arrived at as would prove of general application?

3. Would you be prepared personally to assist (a) in the formation of such a standard, and (b) by the adoption as far as possible of standard pipes, in your own case?

4. General remarks on the subject.

This circular was sent to all members of the Association in active charge of waterworks, to the leading consulting (waterworks) engineers, and to the principal pipefounders in this country.

Replies to the number of 119 have been received, only 2 of them being unqualified disapprovals.

The general result of the preliminary enquiry being, beyond question, favorable to further action, the question was brought forward to the annual general meeting of the Association. The prin-

cipal points raised by the committee were as under :—

1. That varying standards should be adopted for varying pressures.

In our opinion, there can be no doubt that this is essential if the standards are to be rendered capable of general application, but it is also evident that if manufacturers are to be expected to stock the standard pipes to any practical extent, the number of standards for each size of pipe must be kept as low as is reasonably possible.

2. That the standards should be limited to the smaller diameters, as, for example, those under 16 in.

This point is one which requires careful consideration, but, in our opinion, it will depend very largely upon the relative quantities of each size of pipe required annually in the course of ordinary waterworks practice. It would evidently be unnecessary and absurd to include large diameters, which are only required by some five or six undertakings throughout the country, and in which the conditions as regards water pressure, length of main, nature of soil, and amount of traffic over the line of the mains would vary considerably in each case.

3. That standardisation should extend to water fittingts rules and regulations, pipe flanges, specials, and coating of pipes.

On this head we would remark that the questions of water fittings, and of rules and regulations to prevent waste, are being dealt with by others. In any case, however, we think that these questions would be better dealt with independently of that of cast-iron pipes. The standardisation of pipe flanges has already been taken in hand by the Institution of Mechanical Engineers.

The standardisation of special pipe castings is, of course, closely allied to that of cast-iron pipes generally. There appear to be many points common to all classes of cast-iron pipes (as well as to all classes of pipe foundries) which might with advantage be incorporated in any scheme of standardisation, but each would require to be considered on its merits.

4. That in any scheme of standardisation metric measures of weight and dimensions should be adopted.

We are hardly prepared at the present time to give a final opinion on this point, but, judging from results of previous attempts to alter our notional standards, we have little doubt that this

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suggestion will have to be abandoned as impossible, at any rate for the present.

5. That standards for any given size of pipe should be based upon external diameter rather than internal.

We think it worth while to mention this point as, although to some extent a matter of detail, it is at the same ti me a question of such importance as to amply warrant a full and ample discussion. It offers the important advantage of rendering all spigots and sockets for a given *size* of pipe common to all *classes* of pipe under the different standards of strength, and, further, enables the pattern for any given size of pipe to be used in common for all classes, the variations in thickness being restricted to the core. The chief disadvantage appears to be the fact that the internal diameter would no longer be an accurate gauge of the size of the pipe, but that thin pipe would be slightly larger than the nominal diameter, and thick pipes slightly smaller.

It must, of course, be obvious that no attempt at standardisation could be successful unless it had the sanction and support both of the leading waterworks engineers and the principal pipefounders. The committee strongly urge that before any details are decided upon, they should be submitted to all those most intimately associated with the industry in question, and as far as possible modified to meet any views that might be expressed by them. In fact, it appears—at least, for the moment—that the most effective procedure would be either by a general conference of all engineers and manufacturers interested in the matter, or, should such a conference be impracticable, by some form of *plebiscite*.

DISCUSSION ON "INCREASING FOUNDRY PRODUCTION."

The American Machinist, Aug. 14, 1902, in an editorial, has this to say on the subject under the title "Molders for Molding":—

We reprint in this issue the principal portion of another of the unusually excellent series of practical papers presented at the recent meeting of the American Foundrymen's Association. The paper briefly but clearly tells of the method adopted in a certain foundry to increase the relative and actual output, so that it could

keep up with the demands of the machine shop which it was its function to supply. The method adopted was simple and commonsensible. The molders were allowed to put in all their working hours in molding, and the hard work at both ends of the day which does not call for the molder's skill, but which it has been the traditional custom of the trade for molders to do, was relegated to unskilled hands that could do it quite as well or perhaps better, and certainly much more cheaply. The anomalous thing is that there should be an opportunity to tell such a story as this or that the practice recommended should not have been adopted in that foundry and in every other years ago. The work of shaking out the flasks and taking out the castings, of shoveling over and tempering the sand and of handling and pouring the molten metal, except in rare cases, was never legitimate work for a highly skilled molder. It not only occupied a large fraction of his valuable time, but it actually impaired his skill and reduced his efficiency for the actual molding operations. Molding work is surely hard enough work for any man, without the unnecessary addition of any portion more exhausting. We are well aware that for years there has been a breaking up of old practices in the large specialty foundries, and that there the molders have been largely emancipated, but in the general machinery and jobbing shops the old traditions and practices still largely prevail, and they cannot be too soon abolished.

While from time immemorial molders have been molders only part of each day, machinists have generally been machinists from one whistle blow to the other, so that here would seem to be no lesson for them. This is not so sure after all. There are still machinists and machinists, and much is still to be gained in rightly apportioning their work. There is work that demands the highest skill and judgment attainable, and then there is much other work that any so-called machinist can do. The grade of skill required for roughing out and that required for finishing most lathe work, for instance, is distinctly different in its exactions. Why should the best finisher, the most reliable maker of fits, waste his time, speaking comparatively, in doing the rough turning and the preliminary work? And there is not only the man but the tool to be considered. It is very desirable to have some tools that shall be as accurate and reliable as possible for the finishing operations, and it is equally desirable to have tools of strength and stiffness, with

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coarse feeds for making as much chips as possible, and these characteristics can never be combined and maintained in the single tool as well as in two or more tools. There can no more be any objection to the suggested arrangement on the ground that the man who begins a job in the shop has a "right" to finish it, because, as a matter of fact, in these days very few men begin and finish a job. The general practice is to pass the work from one machine to another, and therefore also from one man to another, and we are merely suggesting the looking out for additional opportunities for this generally profitable practice.

DISCUSSION ON THE PROPOSED STANDARD SPECIFICATIONS FOR SAMPLING IRON.

Mr. Henry Souther writes as follows :—

The only point to which I take exception in the specifications is included in the last sentence of paragraph three, where the magnet is suggested as a precaution against dirty samples previous to analysis.

I experieneed a very great deal of trouble in getting samples free from sand from my clients and am obliged to repeatedly warn them and instruct them as to clean sampling. In no case have I resorted to the magnet, inasmuch as I believe its use to be a dangerous expedient. I often see small particles of iron attached to particles of sand with the iron in large enough proportions to be picked up by the magnet. Also in the case of very soft irons, graphitic carbon is present in considerable quantities and this is not picked up by the magnet. It should be, as it forms a legitimate part of the iron.

These two sources of error in connection with the use of the magnet recommended by you, are enough to condemn the use of the magnet at all. The only way to get good results is to insist on clean samples, something quite possible to obtain with a little intelligent thought while drilling the pig. As a rule a boy learns this and succeeds in getting clean samples much quicker than an ordinary man about the foundry, who does not seem to be impressed with the importance of cleanliness as much as a boy is.

[Note by the Secretary. We would like to hear from every-

one interested in the subject of standard method of sampling iron. The method proposed by the committee will come up for final adoption at the next convention and a thorough ventilation and the pointing out of defects in the specifications as drawn up is requested.]

PROCEEDINGS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

Our Association having membership in this Society, its proceedings are naturally of interest. Through the agitation of many of our members the subject of cast iron was given an unusual amount of attention as a perusal of the extracts of the proceedings printed below will show.

The Iron Trade Review, June 19th, 1902. The fifth annual meeting of the American Section of the International Association for Testing Materials was held at Hotel Traymore, Atlantic City, June 12, 13, and 14, and throughout was a very successful and profitable meeting. Its most noteworthy action, as affecting the organization itself, was the change of the name of the Association as indicated below. The attendance was the largest in the history of the organization, more than 75 persons being registered. The present membership of individuals and firms is 185. A vigorous campaign is to be prosecuted to increase this number to 1,000.

The meeting was opened Thursday by the President, Prof. H. M. Howe, who in his annual address referred to the importance and value of the society as a means for perfecting methods of manufacturing materials of construction and their use, by the exchange of ideas and experiences among the members. He spoke of the apparent differences in the practical workings of the American Section of the International Association for Testing Materials and the lines of operation of the European sections, inasmuch as the European part of the association lays more stress upon the establishment of methods of testing, while the American branch is more concerned about the standardization of methods.

The desirability of putting the American section upon a more solid basis of organization at home having become manifest, it was proposed in the opening business session and unanimously carried to change the society into a chartered organization under the name of: The American Society for Testing Materials. A constitution

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and by-laws were adopted and the society assumed its new position among the technical associations of the country under very favorable auspices. The new character of the society does not at all disturb relations with the international body. The by-laws provide that any person, corporation or society can become a member of the society and of the International Association for Testing Materials simultaneously, the annual dues being $3., of which $1.50 is transmitted by the secretary to the International Association for Testing Materials.

The following officers were elected to serve during the ensuing two years :—President, Dr. C. B. Dudley, chemist Pennsylvania R. R. Co., Altoona, Pa.; Vice President, Robert W. Lesley, Philadelphia; Secretary, Edgar Marburg, professor of engineering, University of Pennsylvania, Philadelphia; Treasurer, James Christie, mechanical engineer, American Bridge Co., Philadelphia; Member Executive Committee, John McLeod, assistant to the president of the Carnegie Steel Co.

The Ethics of Testing.

The concluding paper of the second session was by P. Kreuzpointner on "The Ethics of Testing." Among other things the speaker said that "in order that the work of devising specifications and the testing of materials of construction have a reliable commercial value to both producer and consumer, we must follow faithfully the teachings of science; but in order to perform work faithfully, we must be able to command a high sense of duty and a high sense of duty means a high ethical standard. This ought to put the work of testing upon a higher plane than mere mechanical skill, and it is to be regretted that the factor of ethics receives so little recognition in estimating the commercial value of the man's work who does the testing. In work requiring purely mechanical skill, the result can be measured by rule and compass and these are tangible quantities. In testing, however, the results must be accepted in good faith and the man's integrity becomes a leading factor in the reliability of the work performed, because no one can measure or caliper the result.

"Because of this factor of ethics playing such a prominent part

in determining the commercial value of the science of testing, it is neither scientifically correct nor commercially judicious to consider the work of testing of low commercial value, to be performed by any man of average intelligence, who is willing to accept low pay. And the closer the minimum and maximum limits of the specifications are drawn, the more complicated the work and method of testing is, the more this holds good." Attention was called to the national importance of this matter, much depending on the degree of confidence our work of testing and that of devising specifications commands abroad.

A Session on Cast Iron.

Last but not least was the cast iron session of Saturday morning with a number of interesting papers giving promise that henceforth cast iron will form an integral part in the proceedings of the society. Prof. Howe was unable to present his promised "Notes on the Constitution of Cast Iron," in which he was expected to give in some detail his theory of the relation of steel and cast iron. The first paper presented was that of W. G. Scott, of Racine, Wis., chemist of the J. I. Case Threshing Machine Co. In the absence of the writer it was read in abstract by the secretary. In the concluding portion of the paper some suggestions were made concerning mixtures, from which we take the following:

"Occasionally it happens that in a given mixture or grade of iron more strength is desired, or a closer grained iron wanted, without materially changing the silicon content. This effect may be obtained by changing some of the other constituents. For ammonia cylinders, air compressors, etc., the following is given: Silicon between 1.20 and 1.60 per cent. where the castings are allowed to cool slowly or are annealed. If not annealed silicon should be between 1.60 and 1.90 per cent. Sulphur should not exceed .095 on account of hardness, but with a high total carbon it may run up to .150 per cent without detriment, although with high sulphur there is always a chance of hard iron and excessive shrinkage, especially in low silicon mixtures. Phosphorus should be kept below 0.70 per cent. and if great strength is wanted should be much lower, say

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0.40 per cent. Manganese should not exceed .60 per cent., except in case of high sulphur, when it may rise to .80 per cent.

"Medium iron for engine cylinders, gears, etc., may be made on the following formula: Silicon, 1.40 to 2 per cent.; 1.50 per cent. giving best results for gears and 1.60 per cent. for steam cylinders. If the castings have thin parts and have to be shaken out of the sand quite soon the silicon should be raised 10 or 20 points. Sulphur is best kept below .085, but if manganese be high (.60 or .70) the sulphur may run to .100 per cent. Phosphorus should not exceed .70 per cent. Manganese should be between .30 and .70 per cent.

"Soft iron for pulleys, small castings, etc., should have silicon between 2.20 and 2.80 per cent.; sulphur not above .085 per cent.; phosphorus may go up to 0.95 per cent. in small thin work, but where strength is wanted it would best be kept below .70 Manganese may be from .30 to .70.

The author laid down an approximate transvere strength of 2,800 pounds for hard iron, 2,500 pounds for medium iron and 2,200 pounds for soft iron. The following rules were laid down: To raise strength reduce graphite, phosphorus and silicon and increase manganese and combined carbon. To reduce shrinkage, increase silicon, graphitic carbon and phosphorus, and reduce sulphur. To prevent blow holes, reduce sulphur and increase manganese. To prevent kish, reduce graphite by increasing scrap or raising manganese.

Dr. Moldenke in the discussion following took exception to the use of the 1-inch test bar advocated by the writer for general use. The engineer should come more nearly in his test bar to the characteristics of the work he expected to use it for.

Mr. Sauveur referred to the claim of some foundrymen that cast iron was entirely different from steel. He believed a very close connection exists between the two. If you eliminate graphitic carbon from cast iron what have you left? Undoubtedly a matrix of steel, and nothing else, with cavities that were once occupied by graphitic carbon. If the cast iron was originally gray you would have a matrix of white iron. A knowledge of steel implies a knowledge of the matrix of cast iron. Suppose we want cast iron with the greatest possible tensile strength; we must use a matrix of the greatest possible tenacity. That means 1 per cent. or .9 per cent.

carbon. A second requirement of strength would be to have as little graphitic carbon as possible. Referring to the control of carbon, the speaker conceded the difficulty of doing this with cupola metal; with the air furnace it was more attainable. The value of metallographic methods in determining carbon in cast iron was pointed out.

Dr. Moldenke remarked that he had been working along the line indicated by Mr. Sauveur. In view of the fact that white iron constituted one-sixth of the foundry work of the country—about 600,000 tons out of a probable total of 3,600,000 tons, and a very large part of the 600,000 tons being chilled work—he believed the metallographic method in connection with chilled castings might become quite important.

Dr. Dudley recounted some of his experiences in the car wheel work of the Pennsylvania Railroad at Altoona. Whenever a new iron was brought to their attention for car wheel work the makers were asked to send several pigs. The iron was cut up into test bars in the pig and broken; then analyses were taken; and finally a piece was sent to the foundry for remelting. The laboratory after making the analysis sent the iron to the foundry with a prediction as to the depth of chill. The foundry had frequent occasion to note the failure of the predictions. The car wheel mixture used at Altoona runs 3.25 to 3.60 in total carbon, about .75 in silicon, .50 in manganese, .50 in phosphorus and in sulphur .13 to .15 now as against .08 formerly. The total carbon is lowered by adding to the mixture from 5 to 10 per cent. of steel rails. The chemical analysis hit the character of the resultant casting quite closely as a rule, but sometimes did not. The speaker found that there was something in cast iron of which little was known as yet, that had a great influence on chill. He questioned if oxygen had much to do with it. Why two irons of identical analysis would not chill alike was still unexplained.

Dr. Moldenke referred to some experience in malleable work presenting similar difficulties. He had taken iron from various stages in open-hearth heats, over the time required for a 12- to 15-ton heat, and noted the differences in the castings. He made two castings of a shape indicated on the blackboard, one end being a cube of 2-inch section, from which the width of the bar was stepped down by ¼-inch diminutions. The hottest iron, taken from the surface of the bath, was used for one of these castings and the cold-

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est for the other. Of the two cubes at the large end of these castings the one poured from hot metal was stronger, and showed considerable chill, while the other was gray. He had found that low silicon iron melted much more quickly than gray or high-silicon iron. Mr. West detailed results of his experiments with hard and gray irons, showing that the former fused first. He found also that metal poured hot chilled most deeply.

The Present Status of Testing Cast Iron.

Dr. Richard Moldenke, secretary of the American Foundrymen's Association, read the following paper:

The following is summarized from conditions in America, as found in current specifications, in the technical literature, and through interchange of thought with the men identified with the testing of cast iron; then again, through discussion with notable men in Europe engaged in similar lines of investigation.

Tests of cast iron are carried out in two ways: By means of a supposedly representative bar, and by testing to destruction. The latter way is the preferable one, provided that it is fair to both consumer and producer. Our car wheel and coupler tests come under this heading, and the testing of pipe will form the text of a special communication to us today by one of our members. Tests to destruction in other lines will follow as fast as the consumer is in position to demand them.

It is, however, universally recgnized that this system of testing is applicable only to a limited range of castings, and that other methods must be adopted to assure us of good results for the general run of the foundry product. This has always been attempted by means of a test bar, with what chances of success remains to be seen. The tendencies were two-fold: First, the short coupon attached to the casting, into which coupon the iron might or might not enter under conditions identical with those of all parts of the casting. Usually the chances were against even a fair representation, and this form of testing is deservedly looked upon with less favor than formerly by those who understand something of the characteristics of cast iron. The second method was to use very long bars (often 5 feet) and test them transversely by the gradual application of a stated load. The bars gave results depending upon the manner and time taken in loading, and are now known to be

altogether too favorable to the founder. Moreover, the conditions of the test were exactly opposite to those met with in practice. An impact test would have been more suitable.

We have, however, today exactly this style of bar in use in Germany. About 3 feet long, square, and of pretty small cross section, the bar is broken transverseely, and tensile test specimens cut from the broken pieces. On the other hand our German friends are desirous to have further light on the subject, and have appointed a commission to study the matter thoroughly. They further compliment us by utilizing our results in their investigations. The German specifications for pipe will no doubt be touched upon by another of our speakers today, for herein they have been active in the Fatherland.

Many have been the tests made on bars, and each line of investigation has had the benefit of at least some previous recorded experience. The result has been the crystalization of ideas, which has probably found as good an expression as any in the recent report of the committe appointed by the American Foundrymen's Association, wherein short, heavy round test bars, and these cast on end, are recommended.

There is, however, another idea embodied in the report just alluded to, and this is so different from those generally accepted that it must be mentioned here Our American founders, who know the material they are producing daily at least to some extent, recognize the fact that even with the best of iron, a casting may be of inferior quality through improper conditions existing at the time of pouring, and this unknown to the average layman. They further know that a weak of unsuitable iron can be strengthened artificially, when making test bars, so that it may pass muster, and yet the casting may be inferior. For these reasons, therefor, in adopting the specificationg they did, our American foundrymen cut loose from the very laudable, but entirely impossible production of test bars which are held to be identical with the casting, and selected a method which would give as nearly as true valuation of the quality of iron going into the casting as possible. If afterwards a casting could be tested to destruction, so much the better. The fact that the iron which goes into a casting is found to be of suitable quality, and of sufficient strength, is the only safe-guard which can really be expected from the test bar anyhow. This presupposes that the

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iron is cast into bars under conditions as fair as possible in the light of our present knowledge; that the bars of the size and shape which will neutralize as much as possible the variations due to the sand, the pouring temperature, and the pouring method, and that no artificial strength, or avoidable weakness be tolerated. By making such tests regularly, a founder can quickly satisfy himself, and possibly his customers, on the score of "quality' so far as the iron poured into the castings is concerned. Even tests to destruction are not always as satisfying.

The present status of the question under discussion seems to indicate that the subject hinges upon whether producers will open their works to customers, and give them every facility to judge for themselves the quality of the iron made by means of the tests just spoken of; and on the other hand, whether customers will accept this as a guarantee of good faith, and the desire to give them the best work that can be made. The customer, it may be added, quickly becomes a competent judge of the good or bad conditions prevailing in the various foundries from which he draws his castings when in contact and direct touch with them.

Foundry Experience Needed for Proper Inspection and Testing of Cast Iron.

Thomas D. West, of Sharpsville, Pa., read a brief paper on the above subject. He said that a compilation of all methods now used for testing the physical properties of cast iron would result in such a variety as to bewilder one not broadly experienced in the different branches of founding. "Of all metals, cast iron is the most complex in its physical structure. This is because of the fact that changes in the rate of cooling like grades of iron and cross sections produce radically different crystalline fracture or grain in the iron. Two pieces of the same cross section and poured from the same ladle of iron, can, by difference in the rate of cooling, be made entirely different in physical structure, one having a soft or open grain, and the other a hard dense grain, or chilled. Again, by uniform section and constant rate of cooling, but varying the silicon, sulphur, manganese and phosphorus, we can produce different grades, varying in degrees from a very soft, open-grained iron to hard or chilled iron.

"Where inspection of appearances, as to smoothness and beauty of finish only is required, or where work is duplicate, as in

the case of car wheels, and subjected to certain prescribed tests that have proved proficient by numerous trials, then lack of foundry experience in the inspector may not be of vital importance. Where the inspection of castings is for the strength, solidity or durability, in castings that cannot be tested by breaking a duplicate, it is rare that the possession of foundry experience cannot prove of value, as the test bar, or any other special method of testing may often fail utterly in ascertaining the true character of a casting. For example, when castings like rolls, punch and shears, or flywheels, of which there are many, break from usage and the fracture exhibits shrink holes or a very porous grain compared with other sections, wherein has the test bar or chemical analysis proved of value, in showing a strong iron or apparent solidity? In connection with the test bar and chemical analysis, the experience of broad founding can, in almost all cases, be well combined in passing judgment upon the durability of these castings. Foundry experience cannot give an inspector an X-ray eye with which to see the interior of castings, but to a certain extent it will aid in determining what may be expected, judging from methods used in pouring and feeding to supply the shrinkage of the parts that might be weak from porosity or shrink holes. There may be cases where an inspector experienced in broad founding can fortify his position by seeing a mold before it is closed, and being upon the ground at the time of pouring and feeding a casting, as it is not uncommon to have a mold provided with proper feeding heads and pouring gates, and yet the feeding be such as not to produce a solid casting.

"Aside from shrink holes, blow holes occur, and it requires foundry experience to judge of their existence. There are certain lines of castings that may have blow holes, while others have not. It generally requires some experience to define a shrink hole from a blow hole, and one can be as injurious as the other. As with a shrink hole, the blow hole may often be best predicted by seeing the methods of molding and casting, and the broader the experience of the foundry inspector the better, in passing judgment upon the solidity or strength of such castings.

"Next in order, is to judge of the evils of contraction. When castings are of disproportionate sections, one part will contract more than another, so as to leave an internal strain that no test bar records can properly indicate. Such strain may be greatly overcome

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by methods of cooling after a casting has been poured. Experience in founding enables an inspector to determine at what points weakness may exist or where to detect slight cracks.

"Sufficient has been outlined to illustrate that there is much beside test bar records needed to pass upon the durability of a casting. Nevertheless, the test bar has often a very important function. Again, in designing form and size and the method of molding and casting test bars, a broad experience in founding is essential. The want of this experience has resulted in methods being advocated that have caused much contention and confusion of ideas and retarded the establishment of what are truly practical systems for testing.

"High Strength of White Iron Castings as Influenced by Heat Treatment."

A. E. Outerbridge, Jr., of Philadelphia, read a paper detailing an experience in car wheel work in 1882, and the conclusions he had drawn from it as to the characteristics of what is termed "converted white iron." In the annealing of a number of car wheels, the dampers of the furnace had been left open by accident and the flames had infringed upon the treads of several wheels, producing soft spots. It was found that the white iron of the chilled portion had been changed to gray iron in spots, the white and gray portions of the tread being in general distinctly marked. The phenomenon was due, he concluded, to the change of some of the combined carbon to the free condition under the action of the flame. The speaker passed from this experience to a discussion of the so-called processes for the conversion of white iron into steel, which were announced now and then. Though sometimes the use of a secret chemical compound was a part of these processes, which converted cast iron axes, hatchet blades, etc., into so-called steel, the speaker considered it demonstrated that heat treatment alone was relied upon for the change. These products he considered to be not steel castings, though so sold, nor malleable iron, since none of the carbon was removed, but midway between the two. The paper discussed at length the changes in the carbon in cast iron under heat treatment and the important influence exerted by silicon. We expect to present it in full in a later isiue.

The discussion, which was participated in by Messrs. Sauveur,

Moldenke and Stanley G. Flagg, Jr., brought out dissent from Mr. Outerbridge's view that the process of converting white iron into gray differed substantially from ordinary malleable methods. It was pointed out that while castings which were to be converted into malleable were embedded in an oxidizing material for the removal of some of the carbon, the malleable methods af today also included annealing without the use of an oxidizing compound. The operation here consisted rather in breaking up combined carbon under the heat treatment, rather than the removal of carbon. Mr. Flagg referred to the use of brick dust, lime and other substances in this way, and to annealing with oil as now practiced by some manufacturers.

Specifications for Cast Iron Pipe.

Walter Wood, of Philadelphia, presented a discussion of "Current Specifications for Cast Iron Pipe." He said that the subject of specifications was now under discussion between water works engineers and manufacturers, with the expectation that final results would shortly be reached. It was also hoped that foreign manufacturers would agree to these specifications and thus make them international. In testing work connected with cast iron pipe founding, practice had changed from the 1-inch round bar to the 2x1-inch bar, 24 inches between supports, the required breaking strain being 1,800 to 2,059 pounds. Iron most suitable for cast iron pipe should range in phosphorus from .5 to 1 per cent.; manganese about the same range, though .75 to 1 per cent. is more desirable; silicon, from 1.25 per cent. for large pipe and 2.25 for lighter pipe. Sulphur is not wanted. Phosphorus is desirable on account of the shrinkage, though sometimes such a shrinkage is found as will pull off the bead of the pipe.

A Contraction Test for Metals.

The paper of Asa W. Whitney on "A Quick Foundry Contraction Test for Metals" went at length into a subject with which the writer is thoroughly familiar. We reserve more detailed account for a later issue. Mr. Whitney illustrated by a diagram a device he had developed to make the contact of the test piece with the chiller continuous and to indicate automatically the progress and extent of contraction of the larger diameter of a frustum of a

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cone. While not exhibiting any samples cast in the style of test mold he suggested, Mr. Whitney showed some photo-micrographs indicating in general what chill is and how much more fully metallography can define it than chemistry alone.

The discussion of the cast-iron papers was interesting and spirited throughout and brought out much valuable material. The suggestion of the relation of steel to cast-iron, which it was expected would be developed iu the paper of Prof. H. M. Howe, is especially important as furnishing the probable keynote of cast-iron investigations in the immediate future.

The members and guests present at the meeting could not but be impressed with the strong spirit of harmony and cordiality which pervaded the discussions, and which augurs the continued co-operation of all interested in the important work of the society. The secretary, Prof. Marburg, worked untiringly to make the meeting successful, and great credit is due all who had part in the arrangement of so valuable and varied a program.

PROCEEDINGS OF THE ST. LOUIS FOUNDRYMEN'S ASSOCIATION.

The Age of Steel, Aug. 4, 1902. The annual meeting of the St. Louis Foundrymen's Association was held on Friday, August 1st, in Parlor B of the Planters' Hotel. The meeting was largely attended and the reports of the officers were read and showed the Association to be in excellent condition.

Mr. Ferd. Schwedtman, president of the Magnetite Foundry Company, was elected president for the ensuing year. Mr. Wm. Medart, secretary of the Medart Patent Pulley Company, was elected secretary and treasurer. The other members of the board of directors elected were Messrs. W. S. Simpson, president of the Christopher & Simpson Architectural Iron Company; Mr. George F. Cottrill, vice-president Green's Car Wheel Manufacturing Co., and J. C. Davis, manager of works for the Leighton & Howard Iron and Steel Company.

The association is in a prosperous condition, and with a new policy which is to be inaugurated, it is thought that every foundry in St. Louis will soon be identified with this association. The chief object of the association is to amicably settle all differences with labor that may arise in the shops of any of the members, arbi-

tration being the fundamental principal of the organization. The association has headquarters established in room 613 Century Building, where Mr. Earle Layman, the assistant secretary, keeps the members advised and looks after the details of the work.

PROCEEDINGS OF THE FOUNDRYMEN'S ASSOCIATION OF PHILADELPHIA.

The Iron Trade Review, March 13, 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, March 5, the president, Thos. I. Rankin, occupying the chair. Notwithstanding the inclement weather there was a fair attendance.

The question of the incorporation of the association came up for discussion, but the matter was deferred pending the amendment of the constitution in order to make the step possible.

M. J. Drummond & Co., 192 Corbin building, Broadway, New York, were elected to membership in the association.

The paper of the evening was presented by Howard Evans, of the J. W. Paxson Co., Philadelphia, the popular secretary of the association, on "The Charlier Oil Fuel Brass Furnace." The paper fully covered the points in the construction and operation of this furnace, as set forth in the article appearing in our issue of February 27. Supplementary to the paper were presented lantern slides showing the furnace and a rig for phosphorizing metals, the furnace during the act of pouring, and the pump rig for supplying the oil fuel. Slides were also shown of the Schwartz melting furnace for brass foundries, and a furnace made in England for use with crucibles. The phosphorization of metals in the furnace was fully explained. The phosphorizer, with a weight on it, was seen to be suspended from an overhead pulley attachment, so that the churning of the metal could be easily and thoroughly done.

APRIL 10, 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, April 2, the president, Thos. I. Rankin, occupying the chair.

The first business taken up was that of incorporating the association. P. D. Wanner, in support of the idea, detailed certain changes in the constitution and by-laws, which would have to be

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made before application could be made for a charter. He then moved, and the motion was seconded by Howard Evans, that the changes suggested be made and adopted.

The election of trustees followed, secretary Evans placing in nomination John E. Harbster, of the Reading Hardware Co.; Charles S. Prizer, of the Prizer-Painter Stove & Heating Co.. and P. D. Warner, all of Reading, Pa., from which place application for the charter is to be made. They were unanimously elected.

The paper of the evening was by Charles Kirchhoff, editor of THE IRON AGE, New York, and dealt with "Trusts and Their Effect on the Business World." The paper, which was not filed for record, was very interesting to all present, The author took the standpoint that in general the consolidations, or so-called "trusts" had proved beneficial to the trade at large, particularly the jobbing trade, and many evils existing in the trade had been corrected. At the conclusion of the reading of the paper, which was quite lengthy, a vote of thanks was extended to Mr. Kirchhoff.

MAY 15, 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia on Wednesday, May 7, the president, Thos. I. Rankin, occupying the chair. There was an attendance of 35 members and visitors. Secretary Howard Evans announced that the steps for the incorporation of the Association had advanced to the point of applying for a charter.

After the adjournment of the meeting the members reassembled in the cafe where the usual luncheon was served and speechmaking was indulged in to a late hour.

The address of the evening was by E. H. Mumford, who spoke of the application of the Tabor vibrator molding machine to large work. Lantern slides were used in illustration. The speaker said that while the Tabor company built probably larger power ramming molding machines for general use and had still larger machines in prospect than were as yet common in the trade, the idea that machine molding was at once to be applied to such castings as loam cylinders with blanket cores, 30-ton bed plates, etc., was more or less visionary.

Molding machines, he said, were variously understood by the trade. Some were called molding machines which only rammed the mold; others which only drew the patterns, and yet many ma-

chines did both. Mr. Mumford then showed on the screen a power ramming machine for molds of large size which was simply a big power squeezer. He next showed a large sized hand ramming molding machine with 10-inch pattern draft which only drew the patterns. There was then shown a complete machine for both power ramming and drawing the patterns for molds 30x48 inches, the machine having 12-inch pattern draft. He explained that in this large machine, while the deeper pockets of sand around the pattern had to be more or less tucked by hand, yet the main body of the sand in a flask each half of which is 16 inches deep was rammed by the machine itself, and showed how the entire working of the machine was carried out from one station by the operation of two valves.

The Tabor molding machines as built today do their ramming by a quick blow. The speaker thought this method of ramming had some advantages over the slow pressure inasmuch as it took advantage of the fact that the loose sand contained air which more or less livened up the sand when the blow was put upon it quickly.

The hand ramming machine which was shown was explained to be useful especially for such deep work as couplers, oil boxes for cars, etc., and details of the machine were shown illustrating the application of various forms of stripping plates to such patterns as require stripping.

The 30x48-inch complete machine which was shown on the screen in detail and in general elevation, Mr. Mumford said began work on castings of the nature of covers for journal bearings, having dry and chambered cores and weighing 1,000 pounds each. The output on this machine, he stated, was 12 molds, or 12,000 pounds from a molder and helper. In connection with the work on this machine it was explained that wooden stripping plates were used on some of it, the stripping plates in some cases being clamped to flasks when lifted from the machine and returned to the machine afterward. The stripping plate and the vibrator were often used simultaneously, and sometimes one sometimes the other. The use of the wooden stripping plates clamped to the flasks and lifted from a machine with them, Mr. Clark at Schenectady has found to save the necessity of bars in the flasks on this large work. To make possible the use of such stripping plates no change in the machine is necessary, the stripping plate covering the flask frame and pattern

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plate together, and on hand ramming machines for such work as oil boxes, sheet brass stripping plates about 3-16-inch thick are successfully employed. The speaker said that he had stripped 5x9-inch oil boxes on one of the Tabor machines with a sheet of ordinary roofing tin made into a stripping plate for the work in an hour.

The discussion which followed the address developed the interest which all foundrymen have in knowing how far machine ramming can go on large work and Mr. Mumford made it very clear that no builder of power ramming machines would pretend today that close spaces between flasks and patterns or deep pockets in the pattern surface, such, for instance, as the pocket in a grate bar could be rammed by power. This would be possible if sand could be treated as a fluid, but it cannot, as it moves very little out of the direct line of pressure and its friction on itself and its surroundings is very great.

Asked to forecast the future as to the size of work on which molding machines would be used, the speaker stated that his company was at the moment building a power ramming and pattern drawing machine to handle flasks 28x70 inches, the two power ramming elements of which each weighed 20,000 pound, to produce castings weighing from 900 to 1,200 pounds each, and that he saw no reason why the radically new principle involved in this machine should not be applied to castings molded in flasks and weighing 10,000 pounds.

JUNE 12, 1902. The 119th meeting of the Foundrymen's Association was held in the Manufacturers' Club, in Philadelphia, on Wednesday evening, June 4, with a good attendance of members. The president, Thos. R. Rankin, occupied the chair.

The Secretary read an invitation from the Secretary of the American Foundrymen's Association, Dr. Richard Moldenke, inviting the members of the Philadelphia organization to the Boston Convention, June 17- 19.

Mr. P. D. Wanner presented the papers covering the granting of the charter of incorporation of the Association.

Mr. J. Wesley Pullman, of Philadelphia, was a candidate for membership, and by a unanimous vote was elected.

A letter was read from Mr. Antonia C. Pessano, of the Geo. V. Cresson Co., Philadelphia, and chairman of the Executive Committee of the Association, resigning his office. This action was

due to his removal from Philadelphia to become president and general manager of the Great Lakes Engineering Co., Detroit. Mr. Pessano's resignation was accepted with regret. Mr. J. S. Stirling referred to the great interest Mr. Pessano had always taken in the Association's affairs and said that the resignation could not be accepted without comment. He therefore moved that a committee of three be appointed to prepare a suitable resolution conveying the regret of the Association that so valuable an officer should be lost to them, and the best wishes of the Association for his success in his new field. Messrs. Stirling, Wanner and Devlin, were appointed such a committee, and later presented the resolution which was passed and ordered to be engrossed and forwarded to Mr. Pessano.

Mr. P. D. Wanner then read a paper on "How many hours shall constitute a day's work," after which Mr. A. G. Warren spoke on the "Paxson-Warren Sand Blast System," both of the papers being discussed.

The meeting then adjourned for the summer.

PROCEEDINGS OF THE GERMAN FOUNDRYMEN'S ASSOCIATION, DUESSELDORF, JULY 10-12.

Many of our American foundrymen have made a special trip to Duesseldorf to visit the Exposition there. This is especially rich in the products of iron and steel. There was little wonder therefore that the German Foundrymen's Association met in convention there, where the auspices are so favorable. The fact alone that here were exhibited the results of the most skillful manipulation of the foundry product, by firms which are the strongest competitors indicated the necessity for a close union on the part of foundrymen, in order that progress might be as general as possible, and that the individual would not be at so great a disadvantage in the open market. It is stated that this feeling was generally expressed by those in attendance, a feeling with which we in America may well reckon.

The first topic under consideration was the condition of the market. In spite of the diversity of opinion, it was clearly shown that the conditions in Germany in the foundry trade were not so desperate as is generally supposed. Inquiries were becoming more

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plentiful, and if prices were not good, the founder had himself to blame.

On the other hand there was still much to be desired in the market, and the financing of building enterprises was not as it should be as yet. Strange to say there was much bitterness expressed in regard to the undue competition of blast furnaces also engaged in the foundry business. Over here the foundry trade would not take very kindly to a furnace making other peoples' castings. They seem to have this on the other side though.

The loss of business through substitution of wrought iron columns for those of cast iron came in for a share of the convention's time, and it was recommended that special efforts be made to show the undoubted advantages of cast iron columns over the others to the building trades. While we would be a little dubious on this point over here, yet we must praise our German foundry friends for their aggressiveness and the determination not to let business slip by without making a strong effort to hold it. The same was done for the steel castings, which is also making heavy inroads in the foundry trade in Europe. Greater efforts to produce better grades of castings were recommended. This applies to us very pointedly also.

Secretary Scherenberg now read his report, which was adopted without comment. Mr. Kohlschuetter reported on the question of damages for breakage in Railway transit. The attempt to gather statistics of production during the year proved to be unsuccessful. It was pointed out that this circumstance was to be regretted, as good and full statistics are of great value in guarding against undue fluctuations in buying and selling prices, as well as keeping the pulse of the industry normal.

Similarly the sending out of regular market reports was not taken to kindly by the Association, and the work was deemed somewhat outside of the functions of the Association. This is correct as the great Iron Journals are in much better position to give reliable market reports than an association composed of one class of men in the general industry only.

The sum of 3,000 Mark was expended by the Association in the study of foundry conditions. Prof. Wuest had made a number of experiments in connection with the cupola process. The programme for the coming year is to be an investigation of American

versus German cast irons. The effect of basic versus acid linings of the cupola and furnace. The sulphur contents of coke, etc. It would seem then that our German friends are doing vastly more for their industry than we are. The sum mentioned represents much original work, and it would be well for our Association to look into the advisability of following in their footsteps in this regard.

The culmination of interest was reached in the discussion of the Trusts, of which the foundry trade has two. The Pig Iron syndicate and that for coke. Heavy artillery was brought to bear on these octopi, but they were defended with no less vigor. It was shown that there were some things to correct, and the Association appointed a committee to take the several questions up with the trusts for adjudication.

Privily Councillor Juengst, who has done so much to bring about standard methods for testing cast iron in Germany, was made an honorary member (the first one) of the Association.

Kassel was selected as the next meeting place, and the Convention closed with the usual banquet.

Several valuable papers were read, during the special business sessions, and these will be reviewed at another time.

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